

1 **52279/GSL/W277**

WHAT IS CLAIMED IS:

- 5 1. An underground drilling system comprising:
 a wellbore in an underground formation;
 a fixed tubular casing installed in the wellbore;
 a rotary drill pipe extending through the casing and
 having O.D. spaced from an I.D. of the casing or wellbore
 during normal drilling operations;
10 a protective sleeve mounted around the drill pipe having
 a hardness in the range of 75 to 123 Rockwell R;
 thrust bearing collars rigidly affixed to the drill pipe
 above and below the sleeve for maintaining the sleeve in a
 fixed axially position on the drill pipe;
15 the protective sleeve mounted to the drill pipe via an
 internal sleeve I.D. configuration allowing the rotary drill
 pipe to continue rotating within the sleeve at a rotation rate
 sufficient to conduct drilling operations in the formation;
 said internal configuration comprising longitudinally
20 extending and circumferentially spaced apart axial grooves
 formed in an I.D. wall of the sleeve for allowing fluid to
 circulate through a space formed between the I.D. of the
 sleeve and the O.D. of the drill pipe;
 at least one low-friction abrasion-resistant end pad
25 formed on at least one end of the protector sleeve to reduce
 friction between the end of the protector sleeve and an
 adjacent end of the thrust bearing collar.

30 2. The drilling system of claim 1 wherein the sleeve
 has a low-friction abrasion-resistant end pad formed on either
 end of the protector sleeve.

35 3. The drilling system of claim 1 wherein the end pad
 is a single piece integrally formed with the sleeve.

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4. The drilling system of claim 1 wherein the end pad
comprises multiple segments formed in the end of the protector
5 sleeve.

5. The drilling system of claim 1 wherein the end pad
is made of ultra high molecular weight polyethylene.

10 6. The drilling system of claim 1 wherein the end pad
is mechanically attached to the end of the protector sleeve.

7. The drilling system of claim 1 wherein the end pad
has castellations formed around a perimeter of the end pad.
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8. The drilling system of claim 1 wherein the end pad
is attached to a cage embedded in the protector sleeve.

9. The drilling system of claim 1 wherein the protector
20 sleeve has a soft elastomer liner on the I.D. of the protector
sleeve.

10. The drilling system of claim 1 wherein the protector
sleeve has an O.D. including multiple distinct radius external
25 curved surfaces.

11. The drilling system of claim 1 wherein the O.D. of
the protector sleeve includes at least one low-friction
insert.
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12. A protective sleeve for installation around a drill
pipe used to drill a wellbore in an underground formation, the
protective sleeve preferentially contacting the I.D. of a well
casing or bore when the drill pipe deflects off center in the
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 casing or bore to protect the casing or bore from contact with
 the drill pipe or its tool joints during rotation of the drill
5 pipe, and which the sleeve has a generally cylindrical
 configuration with an internal I.D. for contact with the O.D.
 of the drill pipe wherein the sleeve is a multi-component
 construction comprising an outer shell and a liner positioned
 within the shell wherein the shell has a hardness in the range
10 of 75 to 123 Rockwell R and is greater than the liner.

 13. A non-rotating drill pipe protector for use and the
 wellbore comprising:

 a sleeve sized to be placed around a drill string;
15 said sleeve having an I.D. having a plurality of grooves
 for generating a fluid bearing between the I.D. and the drill
 pipe;

 the sleeve having an O.D. including multiple distinct
 radius external curved surfaces contoured for increasing
20 sliding contact surface area, said contoured surfaces
 separated by channels on the O.D.; and

 a soft elastomer liner having a hardness of 60 Shore A or
 less on the I.D. of the sleeve.

25 14. The protector of claim 13 wherein the sleeve has at
 least one low-friction end pad positioned on the end of the
 sleeve.

 15. The protector of claim 14 wherein the end pad
30 comprises multiple segments formed in the end of the sleeve.

 16. The protector of claim 14 wherein the sleeve has a
 low-friction end pad positioned on each end of the sleeve.

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17. The protector of claim 13 wherein the sleeve has low
friction wear pads on the O.D. of the sleeve.

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18. The protector of claim 14 wherein the end pad is
made of ultra high molecular weight polyethylene.

19. The drilling system of claim 9 wherein the liner
comprises multiple strips positioned around the I.D. of the
protector sleeve.

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